Models 402A and 402D
Power Supplies
Operating and Service Manual

This manual applies to instruments marked
402A "Rev 47" on rear panel
402D "Rev 30" on rear panel

Printed in U.S.A.

3235 3.5C 0682

STANDARD WARRANTY FOR EG&G ORTEC INSTRUMENTS

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QUALITY CONTROL

Before being approved for shipment, each EG&G ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

REPAIR SERVICE

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, EG&G ORTEC must be informed, either in writing or by telephone [(615) 482-4411], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The EG&G ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped **PREPAID** via Air Parcel Post or United Parcel Service to the nearest EG&G ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty will be repaired at the standard charge unless they have been grossly misused or mishandled, in which case the user will be notified prior to the repair being done. A quotation will be sent with the notification.

DAMAGE IN TRANSIT

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify EG&G ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment if necessary.

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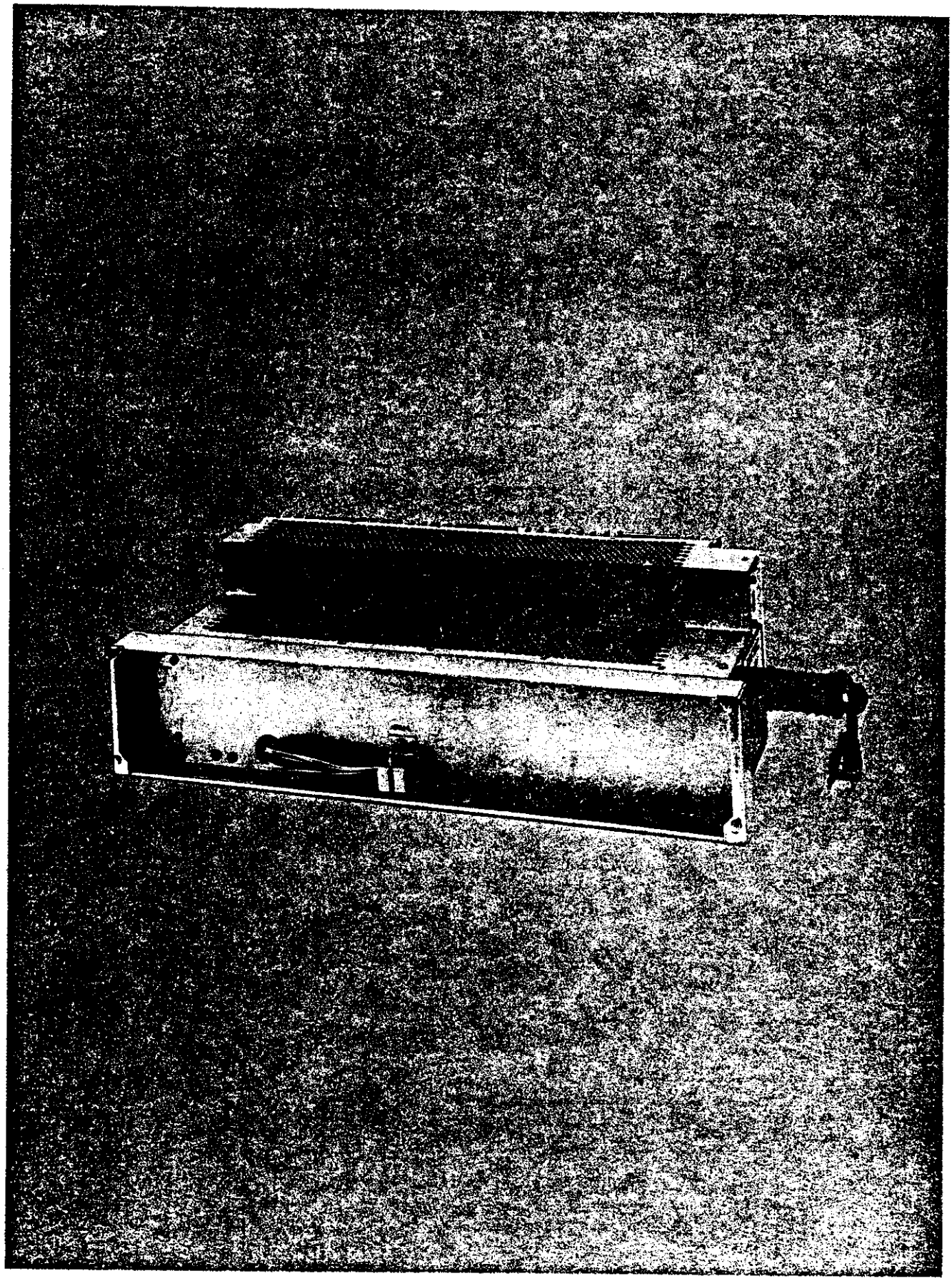


EG&G ORTEC 402D POWER SUPPLY

1. DESCRIPTION

The EG&G ORTEC 402D Power Supply is designed to be mounted in the space provided on the rear of the 4001A(B) Modular System Bin. The Supply was designed to exceed the recommended power supply specifications, Appendix A of TID-20893 (Rev 3), Type V-H, adopted by the AEC Committee on Nuclear Instrument Modules (adopted by DOE).

The 402D was designed for worldwide usage. Input voltage mains of 117 V ac or 230 V ac, 47–63 Hz, may be used. A convenience indicating switch clearly identifies the intended main to use.

The Supply furnishes six standard dc voltages, +24 V at 1 A, −24 V at 1 A, +12 V at 2 A, −12 V at 2 A, +6 V at 8 A and −6 V at 8 A, with a maximum power capability of 132 W at 50°C. The dc outputs are regulated, short-circuit protected, current limited, and thermal protected.

The 117 V ac is supplied to the Bin connector independent of input mains. The 117-V ac power available is limited only by the Power Supply fuse when operating from 117-V ac mains. When operating from 230-V ac mains, the 117-V ac is derived by autotransformer action and is limited to 60 VA output with a dc load on the Power Supply of 132 W.

A control panel is provided on the EG&G ORTEC 4001A(B) Bin for operating and monitoring the 402D Power Supply. An On-Off switch, a power indicating lamp, a thermal warning lamp, and convenience dc monitor jacks are provided. The thermal warning lamp is lighted when the internal temperature rises to within 20°C of the maximum safe operating temperature. The Power Supply is automatically cut off by an internal switch should the temperature exceed the maximum safe operating temperature.

The power transistors are virtually indestructible due to their power handling capability, current limiting, and short-circuit protection. Silicon semiconductors, 85°C capacitors with conservative working voltage ratings, high-quality-carbon resistors, and metal film resistors are combined to produce the 402D Power Supply, which exceeds the TID-20893 (Rev) requirements.

The dc output voltages are adjustable through holes in the top of the Power Supply cover plate, over a ±2% range from their nominal ratings. The adjustment potentiometers are 20-turn cermet potentiometers for superior adjustment resolution and resettability of the output voltages.

2. SPECIFICATIONS

INPUT 100 to 129 V ac, 57–63 Hz, or 200 to 258 V ac, 47–53 Hz. Input current at 117 V is 3.5 A for a 132-W dc output.

DC OUTPUTS The Supply provides six simultaneous dc outputs with the following current ratings:

VOLTAGE (V)	CURRENT (A)
+24.00	0 to 1
−24.00	0 to 1
+12.00	0 to 2
−12.00	0 to 2
+ 6.00	0 to 8
− 6.00	0 to 8

Maximum output power from 0 to 50°C ambient is 132 W. Operation to 60°C ambient, with current derated not more than 3%/°C for temperatures above 50°C.

117-V AC OUTPUT 117-V ac output is limited only by the Supply fuses when operating from 117-V ac mains. Output is limited to 60 VA at 132-W dc load while operating from 230-V ac mains.

REGULATION
±0.1% (typically ±0.05%) for ±12 V and ±24 V, and ±0.2% (typically ±0.1%) for ±6 V over the combined range of zero to full load and input voltage of 100 to 129 V ac or 200 to 258 V ac, when measurements are made within a period of 1 min.

±0.3% (±12 V and ±24 V) and ±0.6% (±6 V) over any 24-hr period at constant ambient temperature over the combined range of no load to full load and input voltage of 100 to 129 V ac or 200 to 258 V ac, after a 60-min warmup.

STABILITY Long-term stability over a 6-month period is better than ±0.5% after a 1-hr warmup at constant load, line, and ambient temperature.

OUTPUT IMPEDANCE <0.15Ω for the ±6-V outputs and <0.3Ω for all other outputs at any frequency to 100 kHz.

TEMPERATURE COEFFICIENT <0.02%/°C over a range of 0 to 60°C.

TEMPERATURE PROTECTION A thermal warning switch will close when the supply temperature approaches within 20°C of the safe operating value. A thermal cutout switch disables the Power Supply when the temperature exceeds the safe operating value.

NOISE AND RIPPLE <3 mV peak-to-peak for all six outputs, as observed on a 50-MHz bandwidth oscilloscope.

VOLTAGE ADJUSTMENTS ±2% minimum range, resettability ±0.05% of Supply voltage.

RECOVERY TIME <100 μs to return to within ±0.1% of rated voltage for all six outputs for any change in input voltage and load current from 10% to 100% full load.

CIRCUIT PROTECTION Both sides of the input line to the power supply are fused. In addition, output current foldback limiting to prevent damage to the Supply and automatic recovery when the demand is removed are provided by electronic circuitry.

All six supplies are protected so that any one can be shorted to any other one without resulting in permanent damage.

Overvoltage protection is provided on ±6 V so that these outputs will not exceed 7.5 V maximum.

OUTPUT CONNECTOR All power and control circuits terminate in a connector, specified by TID-20893 (Rev 3), which mates the Bin interface connector, completing the necessary control and Power Supply wiring.

DIMENSIONS Conform to AEC drawing ND-515 and paragraph L, page A-10, of TID-20893 (Rev 3).

WEIGHT
Net 8.9 kg (20 lb); with 4001A(B) 13.6 kg (30 lb).
Shipping 12.3 kg (27 lb); with 4001A(B) 19.6 kg (43 lb).

3. INSTALLATION

The 402D Power Supply is normally supplied factory-connected to an EG&G ORTEC 4001A(B) Modular System Bin. However, the Supply is designed to TID-20893 (Rev) specifications and may be attached, in the space provided, to any bin manufactured to TID-20893 (Rev) specifications.

For attachment to other than an EG&G ORTEC 4001A(B) Bin, refer to the appropriate instruction manual. The On-Off switch and other controls necessary to operate the supply are part of the Bin and are not furnished with the Power Supply.

For attachment to the EG&G ORTEC 4001A(B) Bin the following steps are advised:

1. Place the Bin on a table with the back part facing you. Place the Power Supply in the proper mounting position, leaving enough space between it and the Bin to attach the interface connector.

2. Mate the interface connector, being careful to align the polarizing pins. Fold and form all wiring close to the connector edges to prevent any wires from being pinched and producing a short circuit in succeeding steps.

3. Mount the Supply to the Bin by securely tightening the four 10-32 screws, being careful not to pinch any wires or to use undue force on any parts.

Unless otherwise specified, the 402D is shipped with transformer connections appropriate for operation on nominal 117 or 230 V mains, according to the selection made with the rear panel slide switch. To change the connections for operation on 100 or 200 V power mains, use the following steps:

1. Remove the top cover.
2. Move the wires from lug #3 of T1 to its lug #2.
3. Move the wires from lug #6 of T1 to its lug #5.
4. Replace the top cover.
5. Set the rear panel slide switch at 117 for 100 V operation or at 230 for 200 V operation.

4. OPERATING INSTRUCTIONS

4.1 POWER SUPPLY LIMITATIONS

The available current from the Power Supply is given in Section 2. Care must be used to ensure natural convection of heat dissipated by the heat sinks and power transformer. For best results, when using at maximum power loadings, the Bin and Power Supply should be in an open space, placed upon blocks at least 1 in. off the table mounting surface to allow maximum ventilation. When used in a rack, maximum attention should be paid to placement of other heat-generating equipment. Adequate unobstructed space on all sides is necessary for convection ventilation and cooling. If the Bin contains other heat-generating equipment, a blower may be advisable to remove the dissipated heat.

When it is necessary to rack-mount several bins and power supplies, especially when other heat-generating equipment is located within the rack, the term "ambient temperature" becomes less clearly defined. A better guide to maximum power loading capability is to monitor the heat sink temperature. Never allow the heat sink temperature to continuously run above 100° C. Although this is not the maximum operation temperature, any additional temperature rise due to other conditions of the system may force the Supply out of tolerance and may cause it to automatically shut down operation. Should your operation produce a temperature of 100°C, a blower to remove the dissipated heat is recommended.

4.2 6-V POWER SUPPLIES CROWBAR OPERATION

Both the +6-V and the −6-V outputs are protected against overvoltage. If for any reason one of these output voltages exceeds 7.5 V maximum in absolute value an internal "crowbar circuit" is triggered, which places a short-circuit across the output of the corresponding voltage. Since this circuit contains an SCR, normal operation, after suppression of the cause of the overvoltage, can be resumed only by turning the power switch of the 4001 Bin to Off for a couple of seconds, and then turning it to On again.

If in normal operation it is suddenly discovered that the +6-V or −6-V output is missing, first check whether it can be restored by following this procedure, after having removed all the modules from the Bin. The crowbar protection circuit of the corresponding voltage may have been triggered by a temporary fault in one module or even by a strong spurious voltage transient.

5. CIRCUIT DESCRIPTION

5.1. GENERAL DESCRIPTION

The 402D Power Supply produces six dc output voltages; ±12 V, ±24 V, and ±6 V. A power transformer reduces the input ac line voltage into six separate low voltage sources. Each voltage source has a separate full-wave bridge, a filter capacitor, and an electronic series regulator. Each regulator is composed of discrete solid-state devices and is completely independent from all other output regulators.

The six regulators are packaged on three plug-in printed circuit boards. The board closest to the heat sink includes regulators for the ±6 V supplies. The board in the middle includes regulators for the negative 12 and 24 V supplies. The other board includes regulators for the positive 12 and 24 V supplies. The 12 V and 24 V regulator boards are identical and may be interchanged.

The rectifiers, series pass transistors, sense resistors, and the SCRs for the 6 V supplies are all located on the large heat sink. The filter capacitors for the 12 V and 24 V supplies are located on their regulator boards. The filter capacitors for the 6 V supplies are mounted in the power supply chassis.

5.2. OPERATION OF REGULATORS

The operation of the ±12 V and ±24 V regulators are all identical. The +24 V regulator is discussed here as an example that is typical for all four of these supplies. The circuit is shown on schematic 402D-0201-S1.

The circuit consists of two parts; these are the voltage regulator and the current foldback circuit. The voltage regulator includes Q10, Q11, Q3, Q4, Q2, Q1, and Q101. The current foldback circuit includes Q5, Q7, Q8, Q6, and Q9.

Transistors Q10 and Q11 operate as a differential amplifier, comparing the voltage from the reference diode, D4, at the base of Q10 to the output voltage divided down by resistors R21, R22, and R23. Potentiometer R22 is used to adjust the output voltage to the desired level. The difference voltage is amplified by Q3 and Q4 to reduce the current through Q2 and to increase the output voltage or

to increase the current through Q2 and to then decrease the output voltage. Q2 drives emitter follower Q1 to supply drive current for series pass element Q101.

In the current limiting mode, the voltage across sense resistor R101 is applied between the bases of Q6 and Q9. When the current level is less than the rated current, Q6 and Q7 conduct. If the output current exceeds its rated value, the voltage at the base of Q6 goes higher than the voltage at the base of Q9 and Q9 conducts. This turns Q8 on to increase the current through Q2 and to decrease the current drive to the base of Q1. The amount of current that the series pass element, Q101, can supply is reduced. When the over-current condition is corrected, normal regulation returns automatically.

The ±6 V regulators operate much the same as the +24 V regulator. The circuit for the ±6 V regulators is shown on schematic 402D-0301-S1. The sense amplifier of the +6 V regulator includes Q11, Q10, Q9, Q26, Q4, Q5, Q2, Q1, and Q3. The operation is the same as for the +24 V regulator. The addition of Q9 and Q26 provides a constant current for reference diode D11.

In the current limiting mode, operation is the same as for the +24 V regulator. Resistors R105 through R108 are used to balance the current in the four series pass transistors, Q105 through Q108. R108 is also used as a sense resistor. The four transistors are used to keep the power dissipated in each device below the maximum rated value.

The "crowbar" circuit is used for over-voltage protection. It includes Q12, D12, and SCR D107. If the output voltage exceeds the zener voltage of D12 (~6.8 V), Q12 turns on and triggers the gate of the SCR. When the SCR turns on, it appears as a short across the supply output and causes the current to fold back. After the cause of the over-voltage has been removed, the supply must be switched off for two seconds and can then be turned on again to restore its normal operation.

6. MAINTENANCE

6.1. ACCESS

The top cover of the 402D Power Supply is attached with sixteen 4-40 Phillips-head machine screws. When all 16 screws are removed the cover can be lifted for access to the plug-in regulator boards. Each regulator board has keying pins to prevent reversal of position in the connector and to prevent insertion into the incorrect location. Be very careful to prevent breaking or removing the keying pins from the connector during either removal or return of the board.

There are copper clips attached to some of the transistors on the printed circuit boards. Their purpose is to ensure equal operating temperatures for these transistors. Do not remove the copper clips from these transistors.

Most of the components mounted on the heat sink can be replaced easily. If access is required to the chassis side of the heat sink, remove the 14 mounting screws that secure it to the chassis and carefully fold the heat sink away from the chassis to prevent breaking any of the wire leads or the soldered connections.

6.2. TROUBLESHOOTING

Any of the three transistor boards may be operated separately without requiring the other boards to be installed in the power supply.

If an output voltage is high and cannot be adjusted down to its proper level, its series pass transistor, mounted on the heat sink, may be shorted. This condition will usually cause damage to the regulator that is mounted on the printed circuit board. Check the emitter-base junction of the series pass transistor with an ohmmeter if a short is suspected. Do not install another regulator board if the transistor is shorted, or the new board will be damaged.

Since the positive 12/24 V regulator board is identical to the negative 12/24 V regulator board, the boards can be interchanged for troubleshooting. Replacement regulator boards are available from EG&G ORTEC.

6.3. TYPICAL VOLTAGES

Tables 6.1 and 6.2 list typical voltages that were measured with respect to ground potential and they are given here as an aid in troubleshooting. These voltage levels are typical of a circuit that is operating properly, but the precise values will vary between individual circuits.

The 12/24 V table indicates the voltages on the board when it is installed at the positive location, furthest from the heat sink. Line voltage is 117 V ac. The 24 V supply is loaded for 1 A and the 12 V supply is loaded for 2 A. All measurements are referenced to chassis ground and are made with a voltmeter that has a 10 MΩ input impedance.

The regulator board for the ±6 V supplies operates in the location closest to the heat sink. The following voltages assume a line voltage of 117 V. Each supply, +6 V and −6 V, is loaded for 8 A. All measurements are referenced to chassis ground and are made with a voltmeter that has a 10 MΩ input impedance.

Table 6.1. Typical Voltages, +12 V/+24 V Supply

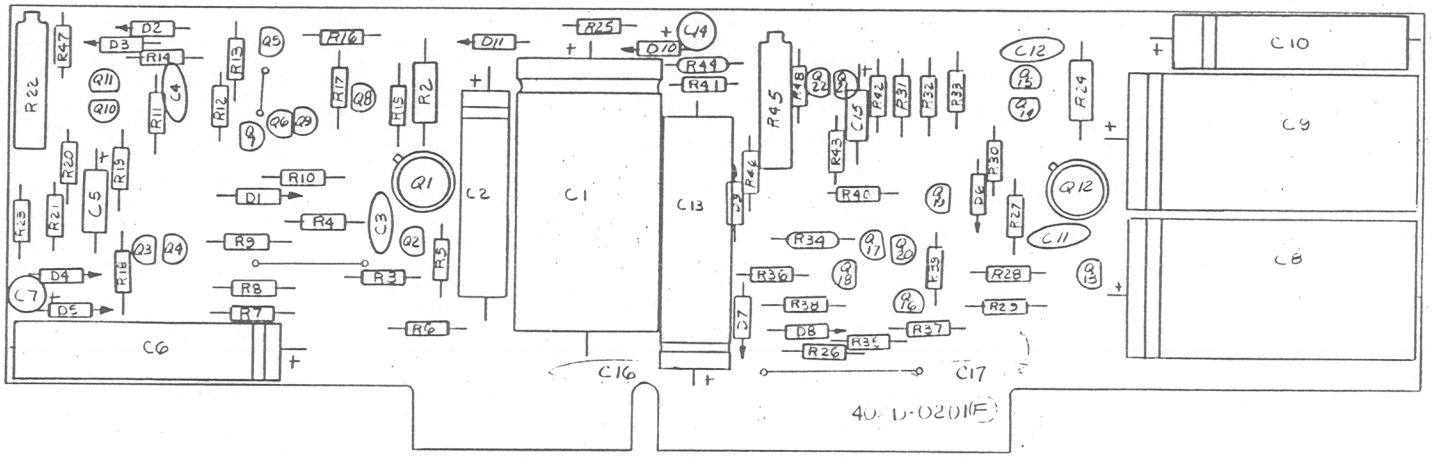
Location	Voltage	Location	Voltage
Q11B	9.2	Q22B	6.4
Q10B	9.2	Q21B	6.4
Q10E, Q11E	8.6	Q21E, Q22E	5.8
Q3B	21.2	Q14B	9.7
Q4B	21.3	Q15B	9.8
Q3E, Q4E	21.9	Q14E, Q15E	10.3
Q2B	0.5	Q13B	0.6
Q1E	25.1	Q12E	13.5
Q1B	25.7	Q12B	14.1
Q1C	37.3	Q12C	18.6
Q6B	23.9	Q17B	12.4
Q9B	24.0	Q20B	12.2
Q5C	25.0	Q16C	13.5
Q5E	36.6	Q16E	17.9
Q5B	36.0	Q16B	17.3
Q7B	24.5	Q18B	12.9
Q8B	24.5	Q19B	12.8
D4 Cathode	9.3	D9 Cathode	6.4

Table 6.2. Typical Voltages, ±6 V Supply

Location	Voltage	Location	Voltage
Q10B	+3.2	Q22B	−2.8
Q11B	+3.2	Q23B	−2.8
Q10E, Q11E	+2.5	Q22E, Q23E	−3.4
Q4B	+4.9	Q16B	−1.3
Q5B	+4.9	Q17B	−1.2
Q4E, Q5E	+5.5	Q17E, Q16E	−0.6
Q2B	+0.6	Q14B	−5.5
Q3E	+7.3	Q15E	+1.2
Q3B	+7.9	Q15B	+1.8
Q3C	+11.6	Q15C	+5.5
Q1B	+9.9	Q13B	+3.8
Q1E	+10.5	Q13E	+4.5
Q29B	+6.2	Q27B	+0.1
Q30B	+6.2	Q28B	+0.05
Q6B	+6.8	Q18B	+0.7
Q7B	+6.8	Q19B	+0.7
Q8E	+10.9	Q20E	+4.8
Q8B	+10.3	Q20B	+4.2
Q8C	+7.4	Q20C	+1.3
Q9B	+10.3	Q21E	+4.7
Q9E	+10.9	Q21B	+4.1
Q9C	+6.4	Q21C	+0.5
Q26E	+0.7	Q25B	−4.7
Q26B	+1.3	Q25E	−5.4
Q12B	+6.0	Q24B	+0.5

6.4 FACTORY REPAIR

This instrument can be returned to the EG&G ORTEC factory for service and repair at a nominal cost. Our standard procedure for repair ensures the same quality control and checkout that are used for a new instrument. Always contact the Customer Service Department at EG&G ORTEC, (615) 482-4411, before sending in an instrument for repair to obtain shipping instructions and the required Return Authorization Number. Write this number on the address label and on the package to ensure proper handling when the instrument reaches the factory.



REVISIONS			
D	402C-15	10-31-78	HF
C	402D-8	10-17-74	MLV
B	402D-4	4-3-76	JC
A	402D-3	10-18-74	RH

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES

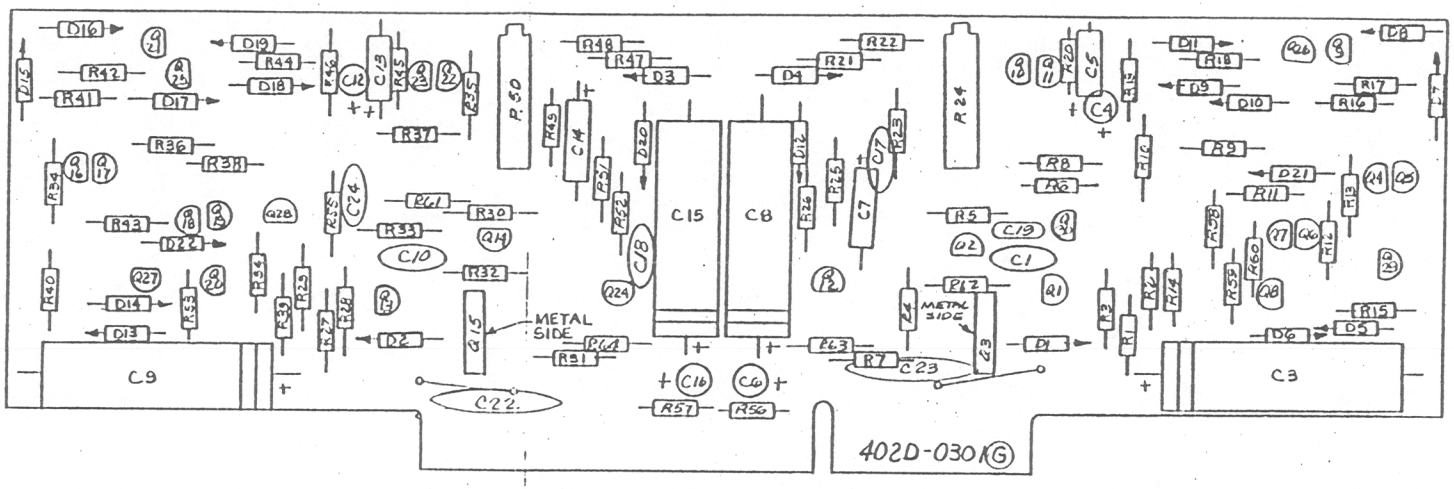
ORTEC INCORPORATED AN EG&G COMPANY
100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

TITLE: MODEL 402D COMPONENT ASSEMBLY

DRAFTSMAN: MLV 8-21-74	RESPONSIBLE ENGINEER: J. AYERS		
CHECKED / DATE	ENG. APPROVAL / DATE	STOCK NO.	
SCALE: 2:1	MFG. APPROVAL: 7/27/74	DRAWING NO. 402D-0200	

PRINTS NO. / REF NO. 23

RFD# 74-0579



F	402D-24	4-22-80	AC
E	402D-15	10-3-78	AC
D	402D-14	5-15-78	DV
C	402D-8	12-21-76	MEK
B	402D-4	6-3-76	MC
A	402D-1	4-2-75	SPM

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES

TOLERANCES

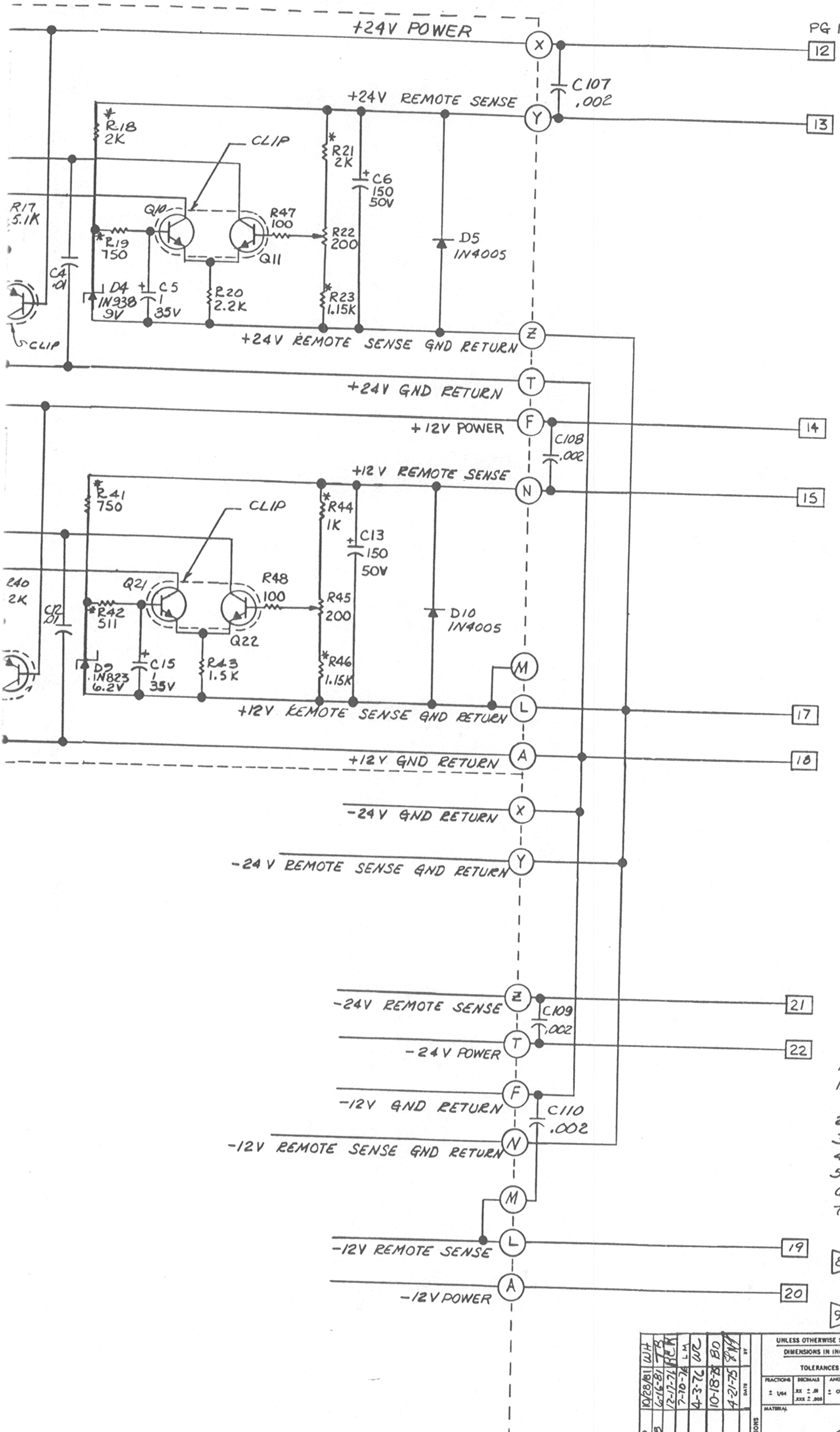
ORTEC INCORPORATED — AN EG&G COMPANY

100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

MODEL 402D
COMPONENT BOARD ASSEMBLY

MLV 8-21-74	J. AYERS	
2/1		402D-030K

RFD# 74-0571



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE 1/4 W, 5% CARBON, RESISTANCE IN OHMS
2. RESISTORS MARKED * ARE METAL FILM 1/8W, 1% TO
3. CAPACITANCE IS IN MICRO FARADS
4. NPN TRANSISTORS ARE MPS 6531
5. PNP TRANSISTORS ARE MPS 6534
6. DIODES ARE IN4009
7. TRANSISTORS Q3 & Q4, Q6 & Q9, Q10 & Q11 Q14 & Q15, Q17 & Q20 ARE CLIPPED TOGETHER FOR TEMPERATURE STABILITY

8. FOR OPERATION ON 90-110 VOLT AC LINE USE LUG #2 AND LUG #5 OF TRANSFORMER INSTEAD OF LUG #3 AND LUG #6

9. INSTALL IF NEEDED

REV.	ECN NO.	DATE	BY
G	402D-29	10/28/81	WH
F	402D-28	6-16-81	TB
E	402D-8	12-17-76	RCK
D	402D-5	7-10-74	LM
C	402D-4	4-3-76	WC
B	402D-3	10-18-78	BO
A	402D-1	4-21-75	RWT

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES

TOLERANCES: FRACTIONS ± 1/64; DECIMALS .XX ± .01, .XXX ± .005; ANGLES ± 0°30'; FINISH √ RMS

MATERIAL

APPLIED PRACTICES

ORTEC INCORPORATED — AN EG&G COMPANY

100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

TITLE: MODEL 402D ±12V ±24V P/S REGULATOR

DRAFTSMAN	DATE	RESPONSIBLE ENGINEER
JC	2-11-74	K MILAM

CHECKED: | ENG. APPROVAL: R.E. Rogers 12/17/76

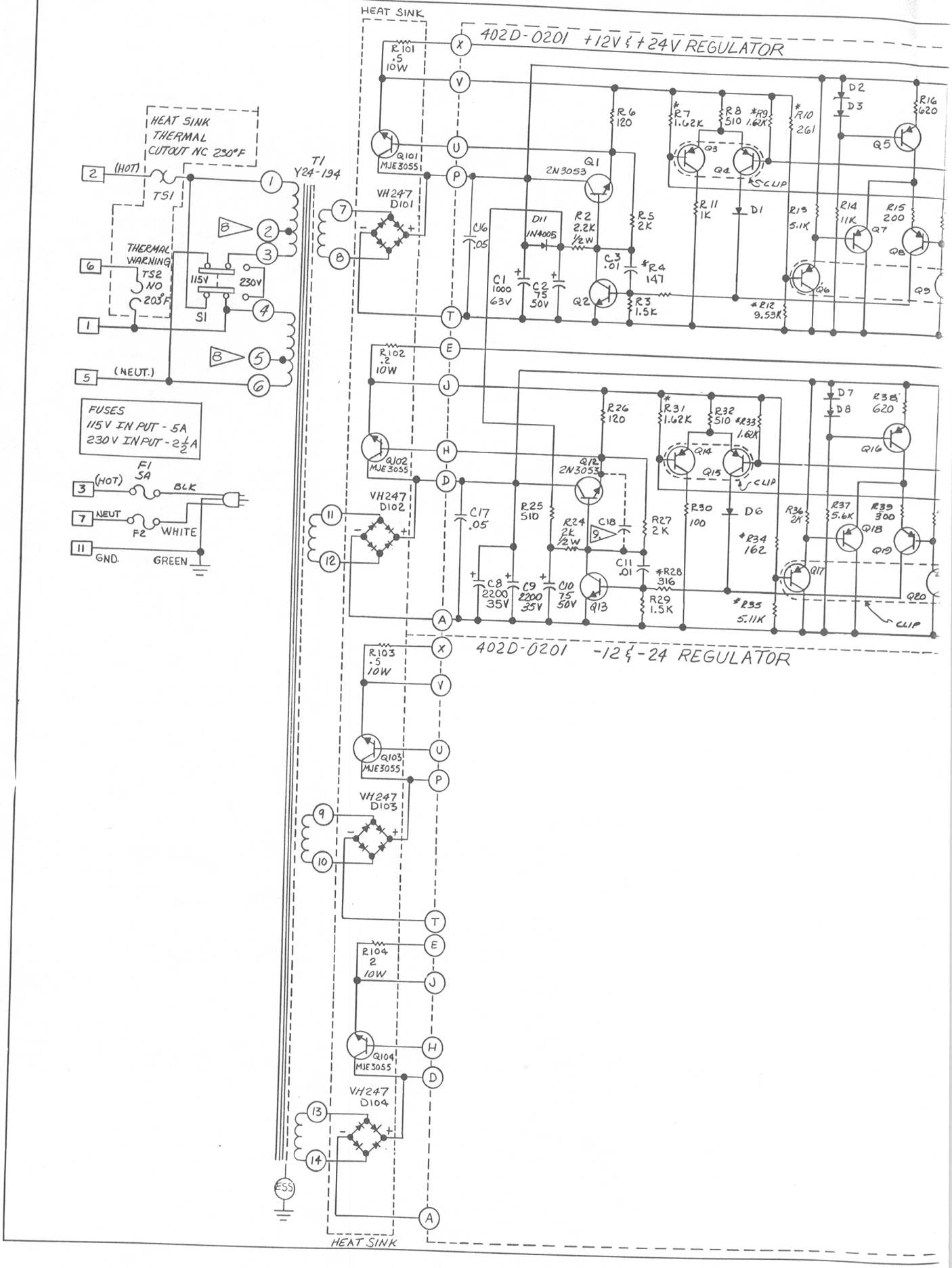
SCALE | MFG. APPROVAL: RWT 9/27/74

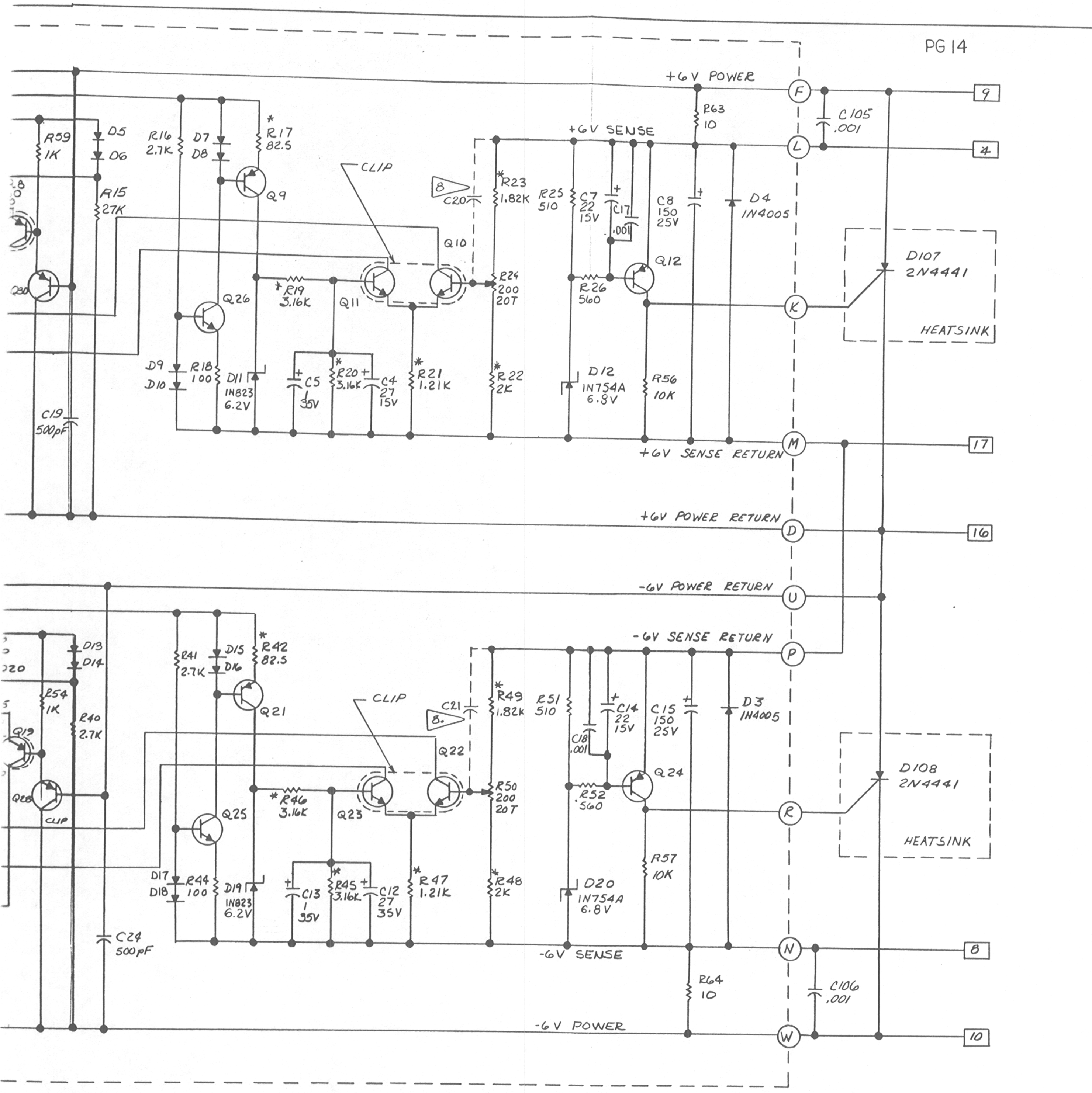
DWG. ISSUED: Q.3.1C 5-27-75 | RELEASED FOR MFG.

DRAWING NO. 402D-0201-S1

PRINTS TO FILE NO.: 9, 53, 54

RFD # 74-0080


HEAT SINK
402D-0201 +12V & +24V REGULATOR
HEAT SINK THERMAL CUTOUT NC 230°F
(HOT)
TS1
T1
Y24-194
THERMAL WARNING
TS2 NO 203°F
115V
230V
S1
(NEUT.)
FUSES
115V INPUT - 5A
230V INPUT - 2½A
F1 5A
(HOT)
BLK
NEUT
F2
WHITE
GND.
GREEN
R101 .5 10W
R102 .2 10W
R103 .5 10W
R104 2 10W
Q101 MJE3055
Q102 MJE3055
Q103 MJE3055
Q104 MJE3055
VH247 D101
VH247 D102
VH247 D103
VH247 D104
Q1 2N3053
Q2
Q12 2N3053
Q13
D11 IN4005
C1 1000 63V
C2 75 50V
C3 .01
C8 2200 35V
C9 2200 35V
C10 75 50V
C11 .01
C16 .05
C17 .05
C18
R1 2.2K ½W
R2 2.2K ½W
R3 1.5K
R4 147
R5 2K
R6 120
R7 1.62K
R8 510
R9 1.62K
R10 261
R11 1K
R12 9.53K
R13 5.1K
R14 11K
R15 200
R16 620
R24 2K ½W
R25 510
R26 120
R27 2K
R28 316
R29 1.5K
R30 100
R31 1.62K
R32 510
R33 1.62K
R34 162
R35 5.11K
R36 2K
R37 5.6K
R38 620
R39 300
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q14
Q15
Q16
Q17
Q18
Q19
Q20
D1
D2
D3
D6
D7
D8
CLIP
402D-0201 -12 & -24 REGULATOR
ESS
HEAT SINK



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE 1/4 W, 5% CARBON RESISTANCE IN OHMS
2. RESISTORS MARKED * ARE 1/8W, 1% METAL FILM
3. CAPACITANCE IN MICROFARADS
4. NPN TRANSISTORS ARE MPS6531
5. PNP TRANSISTORS ARE MPS6534
6. DIODES ARE 1N4009
7. TRANSISTORS Q4 & Q5, Q23, Q22, Q10 & Q11, Q16 & Q17, Q29, Q30 AND Q27 & Q28 ARE CLIPPED TOGETHER FOR TEMPERATURE STABILITY
8. ADD C20 & C21 AS NEEDED (TYPICALLY 500pF)

REV.	ECN NO.	DATE	BY
H	402D-29	10/28/81	
G	402D-27	3-31-81	
F	402D-15	10-31-78	AR
E	402D-14	4-11-78	DV
D	402D-12	9-6-77	AR
C	402D-8		RBA
B	402D-4	4-3-76	
A	402D-1	4-22-75	

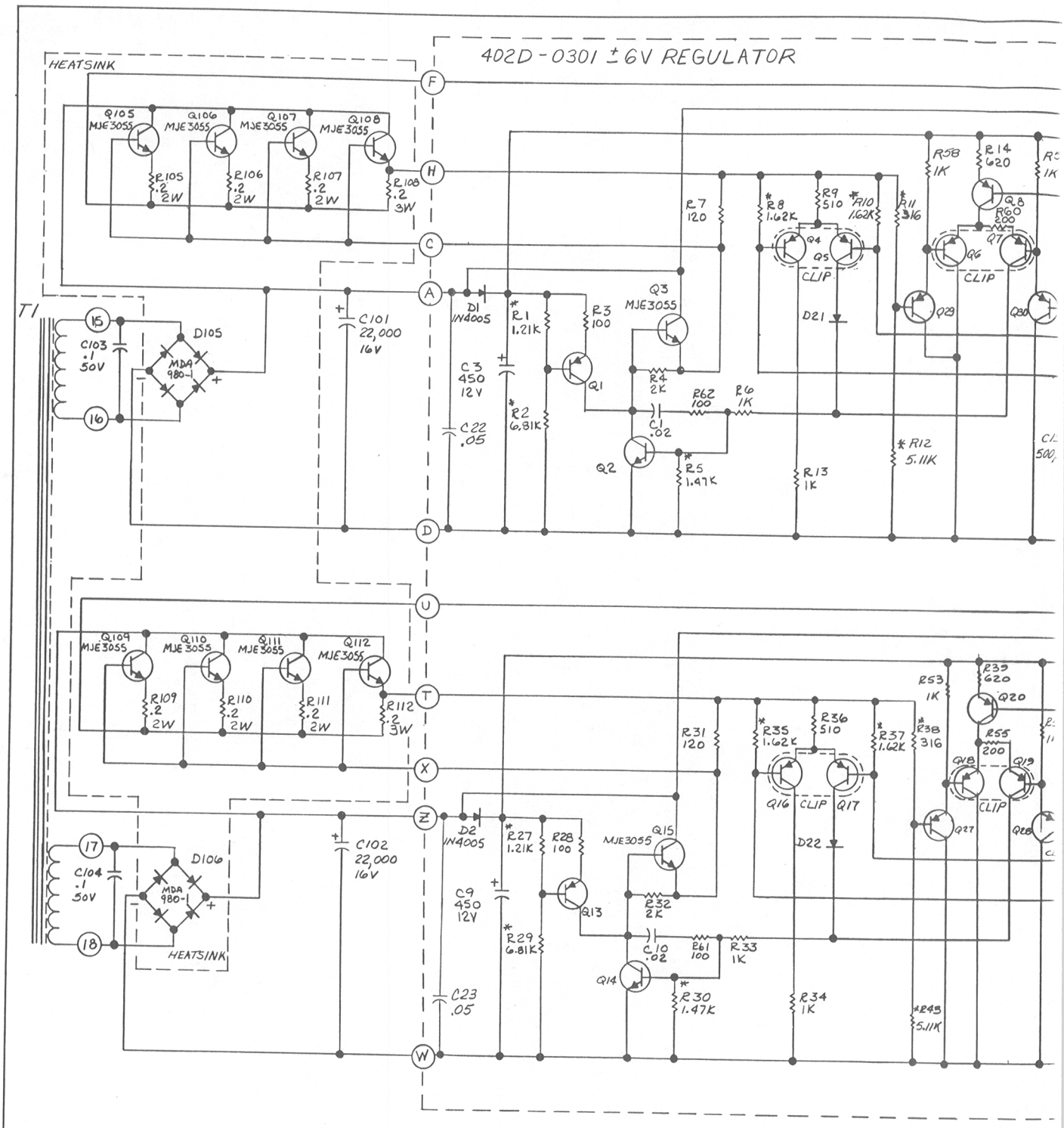
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES
TOLERANCES

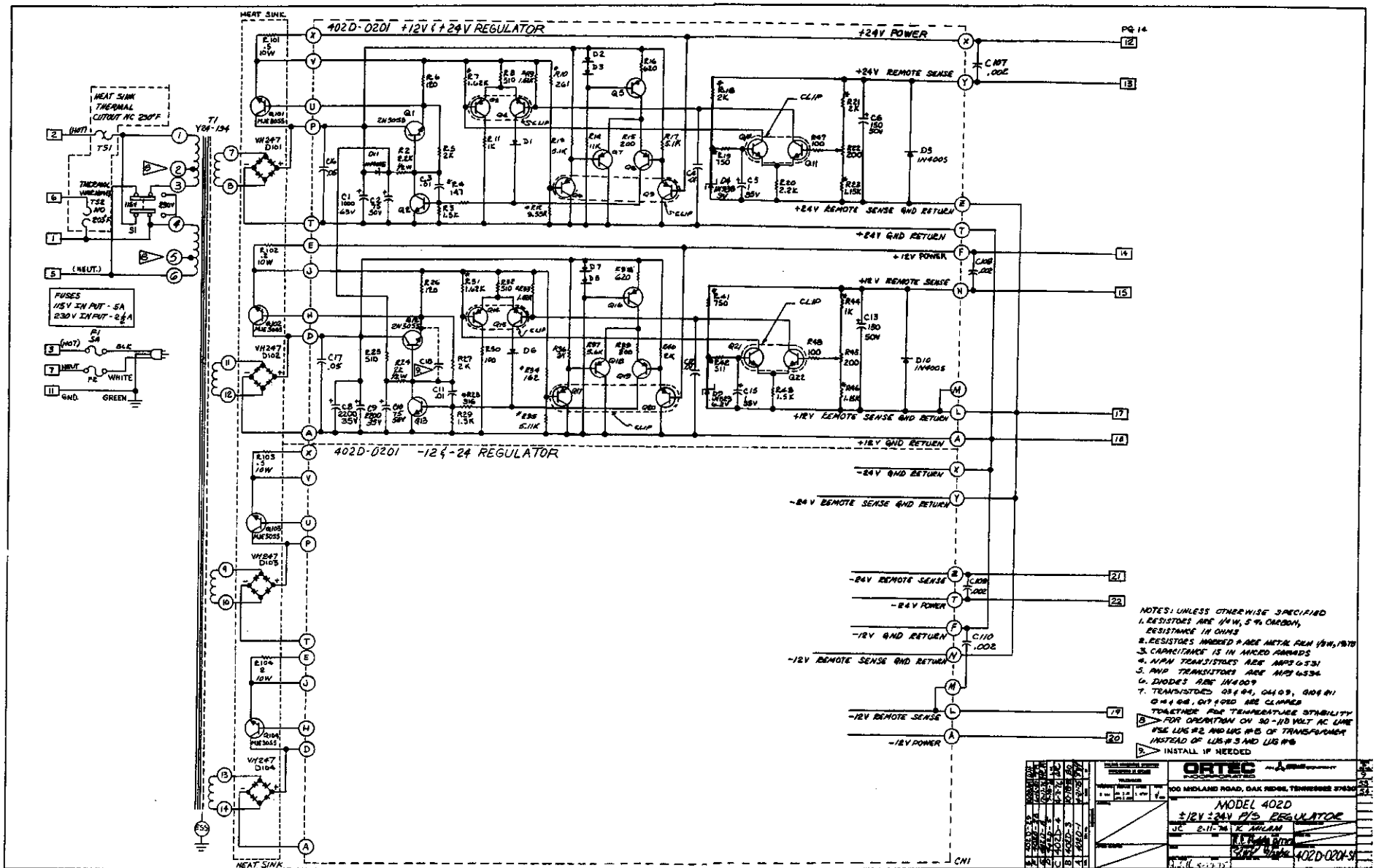
ORTEC INCORPORATED — AN EG&G COMPANY
100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

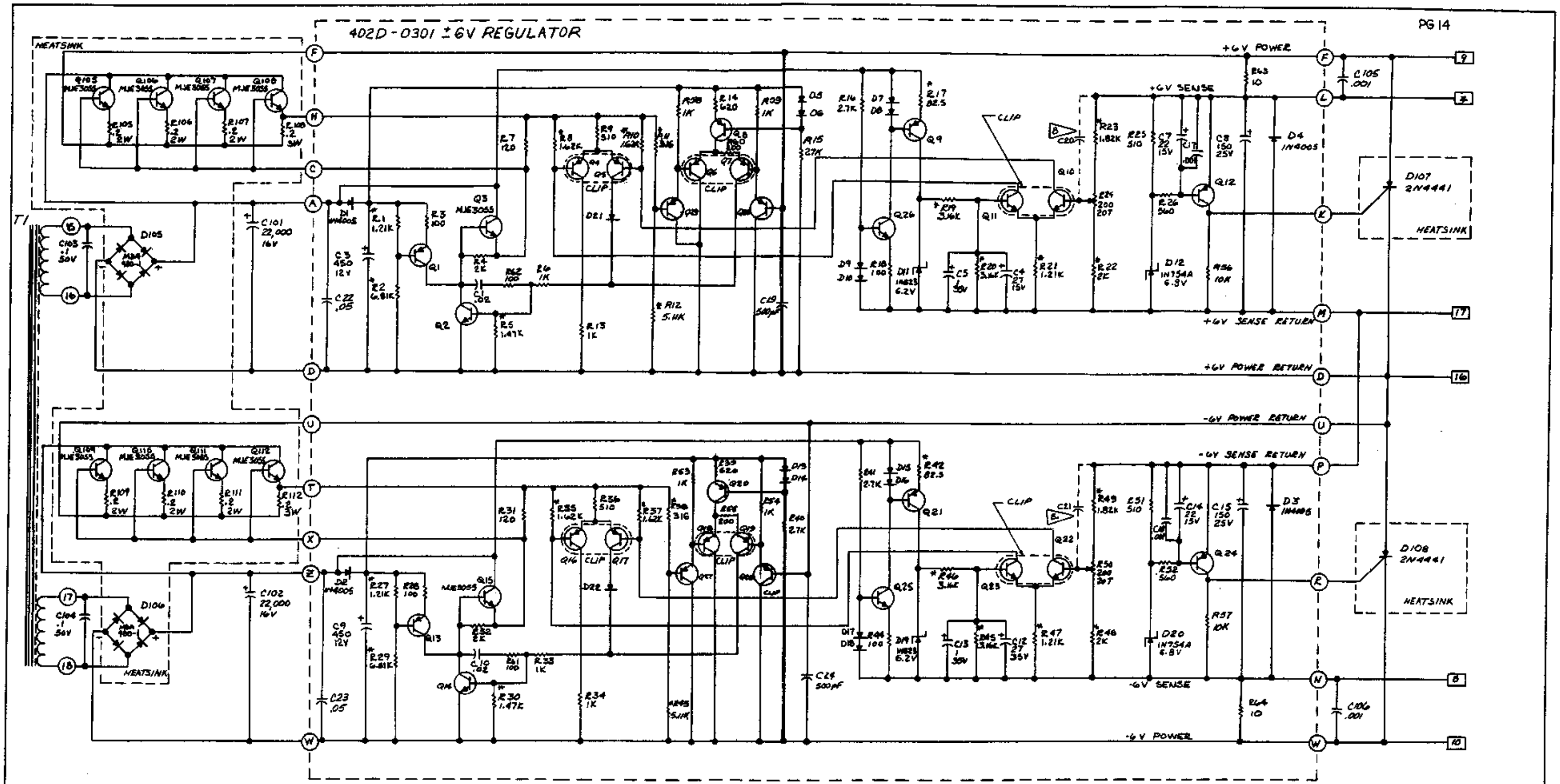
TITLE: MODEL 402D +6-6 VOLT P/S REGULATOR

DRAFTSMAN: JC — DATE: 2-15-74
RESPONSIBLE ENGINEER: K. MILAM
DRAWING NO.: 402D-0301-S1
PRINTS TO FILE NO.: 9, 53, 54

RPD #74-0080


402D-0301 ±6V REGULATOR
HEATSINK
Q105 MJE3055
Q106 MJE3055
Q107 MJE3055
Q108 MJE3055
R105 .2 2W
R106 .2 2W
R107 .2 2W
R108 .2 3W
T1
15
16
C103 .1 50V
D105 MDA 980-1
C101 22,000 16V
D1 IN4005
*R1 1.21K
R3 100
C3 450 12V
C22 .05
*R2 6.81K
Q1
Q3 MJE3055
R4 2K
C1 .02
R62 100
R6 1K
Q2
*R5 1.47K
R7 120
*R8 1.62K
R9 510
*R10 1.62K
*R11 316
R58 1K
R14 620
Q8
R60 200
Q4
Q5
CLIP
Q6
Q7
CLIP
D21
Q29
Q30
R13 1K
*R12 5.11K
Q109 MJE3055
Q110 MJE3055
Q111 MJE3055
Q112 MJE3055
R109 .2 2W
R110 .2 2W
R111 .2 2W
R112 .2 3W
17
18
C104 .1 50V
D106 MDA 980-1
HEATSINK
C102 22,000 16V
D2 IN4005
*R27 1.21K
R28 100
C9 450 12V
*R29 6.81K
Q13
Q15 MJE3055
R32 2K
C10 .02
R61 100
R33 1K
Q14
*R30 1.47K
R31 120
*R35 1.62K
R36 510
*R37 1.62K
*R38 316
R53 1K
R33 620
Q20
R55 200
Q18
Q19
Q16
CLIP
Q17
CLIP
D22
Q27
Q28
R34 1K
*R45 5.11K
F
H
C
A
D
U
T
X
Z
W


402D-0201 +12V & +24V REGULATOR
402D-0201 -12 & -24 REGULATOR
HEAT SINK
HEAT SINK THERMAL CUTOUT NC 250°F
FUSES 115V INPUT - 5A 230V INPUT - 2½A
+24V POWER
+24V REMOTE SENSE
+24V REMOTE SENSE GND RETURN
+24V GND RETURN
+12V POWER
+12V REMOTE SENSE
+12V REMOTE SENSE GND RETURN
+12V GND RETURN
-24V GND RETURN
-24V REMOTE SENSE GND RETURN
-24V REMOTE SENSE
-24V POWER
-12V GND RETURN
-12V REMOTE SENSE GND RETURN
-12V REMOTE SENSE
-12V POWER
PG 14
CH1
NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE 1/4 W, 5% CARBON, RESISTANCE IN OHMS
2. RESISTORS MARKED * ARE METAL FILM 1/8W, 1%TR
3. CAPACITANCE IS IN MFD UNLESS NOTED
4. NPN TRANSISTORS ARE MPS U531
5. PNP TRANSISTORS ARE MPS U534
6. DIODES ARE 1N4009
7. TRANSISTORS Q5 & Q6, Q14 & Q15, Q16 & Q17 & Q20 ARE CLIPPED TOGETHER FOR TEMPERATURE STABILITY
8. FOR OPERATION ON 90-110 VOLT AC LINE USE LUG #2 AND LUG #6 OF TRANSFORMER INSTEAD OF LUG #3 AND LUG #6
9. INSTALL IF NEEDED
ORTEC INCORPORATED
100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830
MODEL 402D
±12V ±24V P/S REGULATOR
402D-0201-S1
RFD# 74-008J



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE 1/4 W, 5% CARBON RESISTANCE IN OHMS
2. RESISTORS MARKED * ARE 1/8 W, 1% METAL FILM
3. CAPACITANCE IN MICROFARADS
4. NPN TRANSISTORS ARE MPS6531
5. PNP TRANSISTORS ARE MPS6534
6. DIODES ARE 1N4009
7. TRANSISTORS Q4 & Q5, Q23, Q22, Q10 & Q11, Q16 & Q17, Q29, Q30 AND Q27 & Q28 ARE CLIPPED TOGETHER FOR TEMPERATURE STABILITY
8. ADD C20 & C21 AS NEEDED (TYPICALLY 500 pF)

ORTEC INCORPORATED
100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

MODEL 402D
+6 -6 VOLT P/S REGULATOR

JC 2-15-74 K. MILAM

402D-0301-S1

PPD # 74-0030